Closeout Presentations

from

Director's Mini-Review

of

BTeV Schedule

May 27-28, 2004

BTeV General Comments

- The project team has done a good job of planning the schedule to enhance float. The 2 phase staging scenario and the forward funding are vital elements.
- The methodology for defining “Need By” and “Ready By” dates is simple and effective – explain it up front.
- Agree that IR spools and quads (175d float) and Pixels (229d float) are the *most* critical subprojects. The project should do everything possible to maximize the float for these subprojects – especially pixels (which is new technology).
- Building (and testing) stage 2 while commissioning and operating stage 1 is a burden on overall manpower, and especially expertise (for system debugging at C0 and component debugging in assembly). May be expert limited in completing phase 2. Deploying physicist manpower will be crucial.
- Schedule as it stands is credible – better if more float in pixels.
- More forward funding would also enhance float (Vanderbilt, Iowa, NSF ?) – buy more schedule.

1.2 Pixels (23 M$)

- **Findings**
  - Not staged – monolithic assembly
  - CD1 63d → 229d float by advancing major purchases – limited by production component orders in FY06
  - All technical decisions already made and vendors lined up.
  - Are successful prototype components tested from the candidate vendors? Yes.
  - Major engineering on vacuum, cooling, movement system well advanced
  - Combine pre-production and production orders which drive the schedule – saves a bid cycle.
- **Comments**
  - Technically challenging project and completion is critical for stage 1 – needs significant float – 229d is, but is barely adequate.
  - Highest schedule (and maybe cost) risk is in the hybridization. 3 vendors have delivered acceptable prototypes, (one is US – preferred since will need to have on-site testing) but yield not known. BTEV absorbs yield risk. Failure of hybridization throws away components (sensors, chips etc) so this defines the size of these orders. Is there sufficient contingency (plan to build 30% more and then 50% contingency)? Plan is to test yield of US vendor using dummy components – this is important.
- **Recommendations**
  - The schedule is driven by major purchases in Oct and Nov 05. Will the funds be available so early in the FY? These orders are for the whole production quantity. The project should consider breaking the orders into parts (options), and forward funding the first part [probably <$0.5M]. This will provide a few months more float and allow flexibility should FY06 funding be limited at the start of the FY.
    - Careful crafting of contracts and vetting multiple vendors is essential.

1.2 Pixels

- Bump bonding yields are likely the biggest risk.
- Common efforts vetting vendors with ATLAS and CMS should continue. The LHC experiments are not yet complete (e.g. PSI bonds at home).
- Parts flow for module production is a schedule concern (sensor, readout, HDI, PIFC).
- The system is a monolith – all items must be in place before the vacuum tank is installed. Ikely to be the critical path for BTeV.

1.7 Silicon (10.6 M$)

- **Findings**
  - Staged, with 4 of 7 stations installed in stage 1 and the remaining 3 one year later in stage 2
  - Float was 6 months at CD1, now 9 months (3 months gained from staged scenario)
  - Now 186 days float to stage 1 and 350d to stage 2
  - The size and technology of the detector (130,000 channels, 30x30 cm2 of silicon, 100 um pitch) is now pretty standard.
  - INFN has given approval for funding – dependent on DOE approval [CD2]. This would allow the production chip and sensor order to be placed earlier and provide an additional 3 months of float.
  - As usual the chip drives the schedule. Present prototype chip performs well and they are close to final design.
- **Comments**
  - Not a particularly technically challenging project.
  - Silicon fabrication follows big LHC orders and it's a simple sensor design – don't expect a serious issue here.
  - Assembly for this size of project can be handled by a relatively modest facility.
  - 9 months float is adequate, 12 months (with INFN funding) would be better
  - Careful contract definition of technically acceptable sensors and a well defined qualification procedure is mandatory.

1.8 Trigger Electronics and Software (19 M$)

- Staging has moved 0.4 M$ and then 2 M$ forward by 1 year and splitting Stage 1 and Stage 2 by 1:1.
- These steps together advance the schedule by ~ 1 year.
- It is probably important to freeze the FPGA technology and press ahead on final design and procurement.
- If more float can be earned by forward funding it should be aggressively pursued as 1.8 is near the critical path.
- Manpower for firmware needs to be addressed.

1.9 Event Readout and Controls (18 M$)

- The new staging scenario moves 1 M$ a year earlier and splits the DAQ, ~ 1:1.
- This strategy buys ~ 1 year of float.
- There are, nevertheless, ~ 6 subsystems all with the same ~ 220 days of float.
- However, both trigger and DAQ need to identify the needed personnel for the associated software tasks.

Does the Schedule Make Logical Sense?

- The BTeV team has an impressive set of tools in place. The L2 managers all appear to have bought in.
- The float has been significantly increased in intelligent ways.
- There is a need now to connect the length of the float to the technical risk and potential mitigation.

Have CD ML Been Included?

- Target set was presented – a work in progress.
- There are PM level milestones that will be crucial to managing the Project to the schedule. These should have small float and some significant probability to fail.
- The upper level milestones are such that FNAL will be judged by their completion. Here, maximum float is called for – declare victory.

Is PM Organization Appropriate?

- A good start has been made. A strong team is in place. There are drafts of a PMP and a PEP.
- Nevertheless, there are several critical open positions – budget officer, integration physicist, procurement specialist and project engineer
- It is likely that the physicist manpower will be stretched for installation and commissioning.
- More details of commissioning would be useful for management planning. Note that CDF and D0 took ~ 1 year to get near to physics output.

Is PM Organization Appropriate?

- Strong PM oversight of the ~ dozen L2 efforts will be needed.
- Rampup of FY04 (4 M$) to FY05 (20 M$) to FY06 (40 M$) is a very steep slope and arrives at a level that is unprecedented for a complex HEP detector.
- Procurement procedures to assure timely purchases and seamless parts flow are crucial.

Is PM Organization Appropriate?

- Manpower may be an issue with CDF, D0, CMS and ATLAS all "operating" simultaneously [Lehman – quote for pixels, crystals, muons, Si strips (US part), trigger and DAQ].
- Management needs to monitor manpower of postdocs and graduate students – "reality check" with annual SOW.
- Make a "redirection survey" – 5 year plan as formalized in a MOU?

WBS 2.0 Interaction Region
J. Strait

Findings

- The quoted schedule float has increased from zero to 9 months since the version presented to the CD-1 DOE review, which results from setting the "need by" date 2 months into the shutdown (+4 months), setting the "ready by" date when the last installed (non-spare) item is ready (+1 month), shortening the spool procurement cycle time (+7 months), offset by lengthening the spool production time (-3 months).
- The design and procurement time for correctors has been shortened by 4 months, so that correctors are no longer on the critical path
- The critical path for preparation of the IR equipment is the design, production and testing of the spools.
- There are multiple "near critical" paths:
  - o Design, production and testing of the *quadrupoles* is 1 month off the critical path.
  - o Design, production and testing of the *correctors* is 3 month off the critical path.
  - o Design and procurement of the *quadrupole cryostats* is 4 months off the critical path.
  - o Design, construction and commissioning of the *magnet test stand* is 5 months off the critical path.
- There was no presentation of the plans for shutdown work, most notably the plans for the 2009 shutdown in which the new interaction region is installed, nor is this yet included in the relevant chapter in the Follow-up Report. However, I went over this with Mike Church on Friday morning.

Comments

- The existence of non-zero schedule float depends on the assumption that the spool production and testing rate will be a factor of two faster than has been achieved for the LHC feedboxes (DFBX). It is reasonable that the BTeV spool production should be faster, but if the rate were only x 1.5 faster, then the float would be gone.
- The team plans to hire several potential vendors to do a 1 month design study of the spool conceptual designs during the next month or so, which should yield a much better understanding of the production rate.
- The spool production sequence assumes all the spools of one type including all spares will be built in one sequence, followed by all spools of the next type. Building all of the installed spools followed by all the spares would move the "ready by" date earlier by 4 months, increasing the float from 9 to 13 months.
- However, if it were required that all spares be available before the end of the shutdown, then the changed production sequence gains only 1 month float. This requirement does not seem to the Committee to be necessary.

- Applying the same production sequencing to the quadrupoles could add 6 months of float to that path (10 -> 16 months)
- The corrector schedule planning is still in some state of flux, and recent discussions with BNL suggest that the float could be several months *larger* than is currently quoted. It may be possible (or necessary) to trade money for time ensure that the correctors stay well off the critical path.
- The test stand will not be ready until 6 months after the first quadrupole is ready to be tested. However, the test time (1 month) is shorter than the production rate (1 per 2 months), so this is not a critical path item. However, the test rate assumed is a factor of two faster than has been achieved with the LHC quadrupoles (which are more difficult to test), and comparable to the fastest rate achieved for a short run of SSC dipoles. If the test duration were actually 6 weeks, then the test stand would become a critical path item.
- The X3 spools must be tested on the quadrupole test stand and this has not been explicitly included in the schedule. It is asserted that a spool test takes only 1 week, and only 4 X3 spools must be tested for the "ready by" date, so this is unlikely to be a serious schedule issue.
- The installation activities during the different shutdowns, culminating the major installation of the IR equipment in 2009, appear relatively straightforward and well planned. That said, the schedules are rather tight, with typically ~10% float. However, the planning does not assume any overtime, and this can be applied to hold the schedule. Thus, the installation schedule appears to be robust.

<u>Recommendations</u>

1) Explore the possibility to accelerate the spool design work (more engineering and design effort) to allow the spool procurement to start as early as possible.
2) Reorder the schedules for spool and quadrupole production so that all the installed devices are built before all of the spares.
3) Perform the spool design studies with potential vendors as soon as possible in order to provide a solid basis for estimating the production rate.
4) Complete the section on the C0 Interaction Region in the Follow-up Report on the Schedule for the BTeV Project, including discussion of the installation schedule.

Has an achievable and clearly defined staging plan been developed?

- The staging plan is relatively simple, well defined, and easy to understand. In most cases it involves installation of relatively complete subsystems in phase 1 (e.g. tracking system planes), with final installation of remaining subsystems in phase 2.
- The phasing has been well thought out to ensure smooth installation of the phase 2 device with minimal interference with the already installed phase 1 subsystems.
- To ensure a robust installation schedule during the 2009 shutdown, not all detectors that are planned to be available then are scheduled for installation. This allows the possibility that more than the promised phase 1 detector may be in place for the first run. BTeV should develop plans that allow them to achieve this if the installation of the (promised) stage 1 detector goes well.
- Although not a subject of this review, BTeV has studied the physics capability of the stage 1 detector to ensure that it can still to world-leading B-physics.

Have the cost impacts of the schedule modification been taken into account and are they judged to be reasonable?

- The cost impacts of the schedule were clearly presented, both the overall cost changes and where costs were shifted earlier or later as driven by the schedule adjustments. These changes appear to be reasonble.
- The adjusted cost profile remains consistent with the funding profile (budget authority) with a reasonable amount of contingency funds being available each year.
- Forward obligation authority from Syracuse and additional funding from INFN has been used effectively to achieve the consistency between cost and funding profiles.

General

-Staging plan reduces schedule risk, sensibly starts commissioning

-correct to add the run time to CD-4 date

- Project team has shown it owns and uses the schedule tools

-the funding/obligation problem fixed

-good website and presentations

-WBS flow diagrams are good

-there appears to be residual float too, the team did not just double up installation shifts etc

-both critical path and 'near critical' path activities identified

-Project management office seeking a project engineer, integration physicist, budget officer, and procurement/QA officer

WBS 1.3 RICH Detector

The staging plan advances the front end electronics for the gas radiator and delays the liquid radiator system until Stage II. Stage I provides 75% of the flavor tagging capability.

The L2 manager presented a WBS work flow diagram, L3 budget profiles, and L2 funding/obligations/labor profiles.

At the CD-1 review the float was 78 days. Now 197 days, not a big risk.
A delay in some PMT purchase has allowed the project to move funds to electronics.
Need to purchase tank in FY05

The tank ready 10/9/07 needed 9/1/08
Liquid circulation system will be ready 9/29/09 needed 7/5/10
(other all about a year float)

The schedule looks robust. The project is accepting recommendations to test prototype detectors in C0 and measure neutron fluxes in the hall early.

Recommendation

none

WBS 1.4 EMCAL Crystals

Stage I calls for rolling in 50% of the loaded EMCAL structure in 2009, the remainder in 2010. This helps the cost profile and reduces some schedule risk noted in CD-1 review. Provides about 60% of the neutral capability.

The L2 manager presented a WBS work flow diagram, L3 budget profiles, and L2 funding/obligations/labor profiles.

Multiple vendors being pursued. Investigating effects of possible conflicts with CMS crystal production needs.

Staged 50% loaded in summer 2008 (229 days contingency)

2nd 50% Sept 242009, 191 days contingency

May 2005 QIE ASIC purchase
Cost increased $400K (to accelerate Chinese crystals)
Analysis of various production scenarios

Might be able to beat the staging plan—buy and load ahead as much as possible depending on other subsystems' needs

CD-1 review recommended adding project engineer.
Reference made to fulfilling this need by using the project office engineer—be careful not to double count
Adding collaborators is being worked on.

Reommendation

Get the procurement package for ASIC purchase ready early—how early??

Understand with the Project Manager whether this subsystem needs a dedicated engineer.

WBS 1.6 Straw Chambers

Part of the staging plan: stage stations 1,2,5,6,7
Give up some redundancy, still excellent tracking.

The L2 manager presented a WBS work flow diagram, L3 budget profiles, and L2 funding/obligations/labor profiles.

During the CD-1 schedule review contingency was presented as 48 days.
Currently, after the re-planning there are 218 days of float.
This was attained by :
-staging plan
-incorrect link
-increase number of production lines 2 to 3

Final design work needs to start in 2005

The cost has increased $285K, arising from updated straw quote, extra staging fixtures to reduce installation time.

An analysis of schedule contiingencies undertaken by the L2 manager.

Recommendation

none

Forward Funding Assumptions, Arrangements, Possiblities, and effect on the schedule

INFN is prepared to fund the Micro-Strip system with a funding profile that adds another 3 months of schedule float onto the existing 6 months. This support includes ~$4-6M M&S as well as significant labor support and contingency over and above that. INFN awaits DOE approval of BteV. These new funds permit redistribution of other project funds to solve many of the scheduling problems.

Syracuse University has agreed to provide $7.5M of forward obligation authority.

These two additional funding sources, along with the staged deployment of the detector, have enabled the development of a schedule consistent with the funding sources available to the project. (see Fig 18 p 43 of support document)

Discussions are underway with other universities and agencies for funds or forward obligation authority. This is all very important at meeting overall schedule goals, bridging unforeseen FY boundary problems. Several hundred $K will be very useful throughout the life of this project.

Recommendation

Continue to pursue further funding and obligation sources.

Vertex, Toroidal Magnet, Beam Pipe - WBS 1.1

General Comments and Findings:

This WBS item concerns the major mechanical components in the C0 Collision Hall, the vertex magnet, toroid magnets, and beam pipe. This equipment is prepared in the Assembly Hall and then installed in the Collision Hall as unit items. The response of this WBS to staging has been to develop a working plan which allows for the installation of the vertex magnet and toroids during short, unscheduled shutdowns. This provides additional float and pushes these items away from the critical path. The installation of the vertex magnet and first toroid is foreseen for FY07. The second toroid would go into during a short shutdown in FY08.

The beryllium beampipe will be installed during the first long shutdown in FY09, since it is a fragile component. Its funding expectations are consistent with this schedule choice.

The float generated by this procedure is constrained by the need to free the space in the Assembly hall for the early components and by the general installation for the later toroid. This float needs to be carefully monitored because it can be affected by the actual dates of short shutdowns. In the worse case, the project would be required to request one or two one-week shutdowns, or an extension of the first long shutdown.

Recommendation:

- Include a discussion of the risk involved in missing the needed short shutdowns. Consider moving this to the installation section since there are few assembly issues.

Muon System – WBS 1.5

General Comments and Findings:

This straightforward subsystem continues to be in good condition as has been found by previous reviewers. The subproject management have participated in understanding the impact of installation staging on the system and have defined a plan than fulfills the need-by dates required, with substantial float. There appears to be no need to modify actual construction schedules to satisfy the staged plan.

- In stage one of the installation, two of the three muon tracking stations will be installed. The estimated ready-by date for these modules are 7/2/07 and 9/1/07, giving a minimum float of 474 working days w.r.t. the need-by date of 8/21/09.

- The final module will be installed in stage two. The estimated ready-by date is 9/8/2008, giving float of 475 days for this module.

- The ready-by date for the last module is earlier than the need-by date for the entire system. Hence the staging requirement is purely an installation sequencing requirement.

- It may improve the clarity of the presentations to clearly separate construction staging from installation staging. For the muon system there would be no need to emphasize construction staging – and it may cause confusion.

- The recommendations of the Lehman review were to hire a full-time QA engineer and pursue forward funding. The project is adding project office staff and a technician dedicated to WBS 1.5. The second recommendation has been addressed.

Recommendations:

Continue to procure and fabricate the muon system on the presented schedule so that its float can be maintained.

Installation and Integration - WBS 1.10

General Comments and Findings:

The Installation and Integration task on BTeV is complicated because of the need for staged installation of the components. At the same time, the I&I task provides need-by dates for all the remaining subsystems, thereby playing a large role in determining the overall project schedule. It is extremely encouraging to see that the project has accepted the management model implied by this scheduling procedure and has been able to produce an integrated schedule using it.

The staged schedule presented by the project has extended the time available for installation in the C0 Collision Hall significantly; the two shutdowns are now planned by the project to be 17 weeks in FY09 (bridging into FY10) and another 13 weeks in late FY10. This results in a 4 week float for all installation activities scheduled in the first shutdown and 2 weeks in the second. Note that the duration of the second shutdown does not have a major impact on other lab operations and can be slightly modified if needed. The project intends, however, to maintain as short a shutdown as possible to increase the time available for physics datataking.

The availability of components going into the Collision Hall obviously impacts the realism and achievability of this schedule. The need-by date system produced by the project based on the installation schedule makes it possible for a uniform evaluation of floats of the component fabrication tasks, and clearly calls out any risk areas. The project should maintain and enhance this scheduling mechanism throughout the project life cycle.

The Lehman review recommendations have been addressed. Subsystems have reevaluated their installation requirements and developed schedule contingency using the staging scenario. Engineering design is clearly realized by the project to be an ongoing process. The project is seeking additional physicist input for additional integration management. The contingency is now 65% (against recommended 75%) but the base costs are better understood and the entire situation is credible.

Recommendation:

Define "yellow-light" warning mechanisms to inform the project management, and particularly the Installation and Integration manager of any significant decreases in float for the component assembly WBS subprojects. An example might be properly tracked elements of the project monthly reports.

WBS 3.0 – Conventional Construction

General Comments and Findings:

The Civil Construction for BteV is technically straightforward, well-understood, and appropriately planned. Since this work was already thoroughly integrated into the project installation plan, the changes in the staged scenario mostly have to do with using float calculations consistent with the need-by/ready-by methodology. Using this the float of the important beneficial occupancy for the the Assembly Hall is 157 days. All floats for other civil construction activities are adequate.

The project has reconfigured slightly to move some high voltage work later to improve the match with the funding profile. In addition, one possible engineering schedule risk has been eliminated by deciding to incorporate additional conceptual design. The schedule does require a timely completion of procurement activities. A detailed procurement schedule has been produced by Fermilab Business Services.

The Lehman review recommendations have been addressed. The recommendation concerning definition and documentation of interfaces with other subprojects is ongoing and will be greatly facilitated by the unified scheduling and float system used for the current schedule proposal. A flow chart for procurement activities exists and is being refined.

Recommendations:

Proceed with the procurement plan for BteV Civil Construction as early as allowed by the project approval process.

Responses to Charge Questions

Charge Question Bullet Number 1:
"Does the schedule have float or schedule contingency of sufficient duration to give a high level of confidence of it being achieved. Has adequate schedule float (or contingency) been allocated on critical path tasks to give this schedule a high level of confidence?"

Findings

A revised schedule for a staged detector has been created. Stage 1 is installed in a four month shutdown beginning August 1 of 2009 and begins commissioning and operation in December 2009. Stage 2 is installed in a three month shutdown beginning July 1 2010 and begins commissioning and operation immediately thereafter.

The revised the schedule to shows much additional float between the construction complete "Ready By" dates and the times needed for installation "Need By" dates. A summary of the floats is given in the following table.

Table 1: Construction "Need by", "Ready by" dates and Floats by subtask. In the staged column, we indicate NA if the device is installed before the 2009 shutdown, No if not staged, Yes if staged. The number in parentheses indicates whether it is needed for the run starting in 2009 (staged detector 1) or 2010 (the full, stage 2 detector).

Subtask	"Ready by"	"Needed by"	Float (working days)	Staged
Magnet, Toroid (1.1)	Jul. '06	Feb. '07	145	NA
Pixel Detector (1.2)	Sep. '08	Aug. '09	229	No(1)
RICH Vessel (1.3)	Oct. '07	Sep. '08	202	NA
RICH MaPMT	Jun. '08	Nov. '09	235	Yes(1)
RICH Liquid Circulation System	Jul. '09	May '10	197	Yes (2)
50% Crystals Loaded	Apr. '08	Sep. '09	229	Yes(1)
100% Crystals delivered	Sep.'09	Aug. '10	191	Yes(2)
Muon Station 2/3 (1.5)	Sep. '07	Aug. '09	474	Yes(1)
Muon Station 1	Sep. '08	Aug. '10	475	Yes(2)
Muon Gas System	Mar. '07	Sep. '08	382	Yes(1)
Straw Station 1,2,5,6,7 (1.6)	Oct. '08	Aug. '09	218	Yes(1)
Straw Station 3,4	May '08	Jul. '10	>540	Yes(2)
Microstrip Tracker (1.7)	Dec. '08	Aug. '09	186	Yes(1,2)
50% of Trigger (1.8)	Feb '09	Oct. '09	156	Yes(1)
100% of Trigger	Sep. '09	Aug. '10	223	Yes(2)

50% of Data Acquisition (1.9)	Sep. '08	Aug. '09	220	Yes(1)
100% of Data Acquisition	Mar. '09	Jul. '10	310	Yes(2)
C0 IR Quads(2.0)	Dec. '08	Sep. '09	200	No(1)
C0 IR Spools	Jan. '09	Sep. '09	175	No(1)
C0 Assembly Area (3.0)	Dec. '05	Jul. '06	157	NA

The project team notes that the critical path activities are the IR, Pixels, Trigger/DAQ, and EM Calorimeter.

Comments

The IR and Pixels will need constant vigilance and attention to deliver these systems as planned. The BTeV team is encouraged to take additional measures as possible to keep these systems on track and accelerate work where possible. The committee believes the special efforts should focus on the spools for the IR and on the hybridization process for the Pixels.

Except for the spools, the proposed schedule is judged to be highly credible with a high likelihood of being achieved. If additional float is created for the spools in some manner such as recommended, building the spools in the order of need without the requirement to have all spares completed prior to beginning operations, the entire schedule will be highly credible with a high likelihood of being achieved.

Recommendations

Strive to maintain the critical path activities and accelerate tasks where possible.

Charge Question Bullet Number 3:
"Is the project ready to start on the date assumed?"

Findings

The project is set to start early in FY05 with key procurements set to be placed in the second quarter.

Comments

BTeV is sufficiently developed to be ready to start on October 1, 2004.

Recommendations

None.

Charge Question Bullet Number 4:
"Have appropriate tiered milestones been identified for tracking progress? Has adequate float been included for the higher-level (director and above) milestones?"

Findings

The use of five tiers of milestones is anticipated. Lists of proposed milestone activities for Tiers 1 (DOE Headquarters – 8 in number), 2 (DOE Site Office – 27 in number) and 3 (Fermilab Director – 92 in number) were provided. Each of these milestones are to have an "Internal Date" and a "Formal Date." Sample dates were provided in the Tier 1 list and some samples were given in the Tier 2 list. The Internal Dates come from the "early start" schedule dates. A procedure for determining the Formal Dates was described wherein the Level 2 and BTeV project managers will insert contingency tasks along the activity paths which will result in a new activity completion date which will be the milestone Formal Date.

Comments

The proposed milestone activities (and dates when available) will need to be discussed and accepted by the milestone owners. The committee believes the Tier 1 and 2 Formal Dates should be set very conservatively with an extremely high probability of being met. Tier 3 milestone Formal Dates may be more aggressive.

Recommendations

BTeV proceed to create the Internal and Formal dates and negotiate milestones and dates with milestone owners. Tier 1 and 2 milestones should be submitted to OHEP with the Revised Schedule by June 15 to support the CD-1 decision process.